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RESEARCH ARTICLE

Owenia caissara sp. n. (Annelida, Oweniidae) from Southern Brazil: addressing an identity crisis

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ABSTRACT. We re-assess the taxonomic status of *Owenia* Delle Chiaje, 1841 from Southern Brazil based on estuarine specimens from Paranaguá Bay (Paraná) and Babitonga Bay (Santa Catarina), and literature records. *Owenia caissara* **sp. n.** is diagnosed by a branchial crown with five pairs of tentacles, branched close to the base of the crown, rectilinear collar with a pronounced lateral slit, two ventrolateral ocelli partially covered by the collar, up to 23 hooks on a single row in the first abdominal segment, regularly curved nuchal shape, regularly moderate teeth curvature, and long and thin scales with oval transition. The description of *Owenia caissara* **sp. n.** reinforces the idea that *Owenia fusiformis* sensu lato is a complex of closely related species that can be distinguished on the basis of both macro- and micro- morphological traits.

KEY WORDS. Estuarine bottoms, Polychaeta, subtidal

INTRODUCTION

Species of *Owenia* Delle Chiaje, 1841 are found from the intertidal zone to 2,000 m deep (Dauvin and Thiébaut 1994). The presumed cosmopolitanism of *Owenia fusiformis* Delle Chiaje, 1844, Oweniidae, originally described from Sicily, Mediterranean Sea, was strongly advocated by Hartman (1959), in her catalogue of the polychaetes of the world. Hartman suggested that the Ammocharidae (a junior synonym of Oweniidae) *Ammochares tegula* Kinberg, 1867, *A. brasiliensis* Hansen, 1882, and *A. sundevalli* Kinberg, 1867, from South America, among many other oweniid taxa from disjoint geographical areas, should be referred to *O. fusiformis*. Subsequent worldwide records (Imajima and Hartman 1964, Plante 1967, Ibanez-Aguirre and Solis-Weiss 1986, Gillet 1988, Dauvin and Gillet 1991) and a biogeographic analysis by Dauvin and Thiébaut (1994) reinforced the notion that *O. fusiformis* is cosmopolitan, based on the presumed high dispersal potential of its larva and the species' capacity to reproduce under variable temperature regimes (Mcnulty and López 1969, Bhaud 1982).

More recently, the cosmopolitan distribution of *O. fusiformis* has been questioned and rejected by many authors based on re-evaluations of the dispersal potential of the mitraria larvae and on more detailed analyses of morphological traits (Blake 2000, Koh and Bhaud 2001, Koh et al. 2003, Guizien et al. 2006, Martin et al. 2006, Ford and Hutchings 2010). The mitraria larva of oweniids can remain in the plankton for up to 30 days (Wilson 1932, Thiébaut et al. 1992, 1994). Although this might suggest a high potential for dispersion, factual data on dispersal potential are still scarce. Dispersion models tested in Banyuls Bay (NW Mediterranean France) suggested that the dispersion ability of mitraria larvae is in fact very limited and could not explain or substantiate a cosmopolitan distribution (Guizien et al. 2006, Verdier-Bonnet and Carlotti 1997). More detailed analyses of morphological traits with potential diagnostic value, previously underestimated in the literature, also showed that *O. fusiformis* has, in fact, a restricted distribution (Koh and Bhaud 2001, 2003, Koh et al. 2003, Martin et al. 2006, Ford and Hutchings 2010). Blake (2000) included novel morphological characters in his partial revision of *Owenia*. After comparing specimens from California and locations near the type locality of *O. fusiformis*, he revalidated *O. collaris* Hartman, 1955 and described a new species, *O. johnsoni* Blake, 2000. He also suggested that conventional diagnostic characters should be supplemented with analysis of the neuropodial rings.

Based on such novel morphological traits, Koh and Bhaud (2001) described *O. gomsoni* from the Yellow Sea in Southern Korea. Koh and Bhaud (2003) also established a new set of traits with forty-eight morphological characters for the identification of *Owenia* species. They used measurements of the thorax, cap-

illary notochaetae, and hooks as novel diagnostic features of species. They confirmed the validity of *O. collaris*, *O. johnsoni*, and described four new species, *O. polaris*, *O. borealis*, *O. petersenae*, and *Owenia* sp. n. not formally named at that time, but later described as *O. persica* Martin, Koh, Bhaud, Dutrieux & Gil, 2006. More recently, five new species were recorded from Australia: *O. australis* Ford & Hutchings, 2010; *O. bassensis* Ford and Hutchings, 2010; *O. mirrawa* Ford & Hutchings, 2010, *O. dichotoma* Parapar & Moreira, 2015 and *O. picta* Parapar & Moreira, 2015.

The taxonomical knowledge of the genus in Brazil is unsatisfactory, although specimens of *Owenia* are often found, and are often numerically dominant in estuarine or shallow shelf benthic assemblages. Ecological surveys, in particular, tend to cluster all species of the genus under the name *O. fusiformis*. *A. sundevalli* and *A. brasiliensis*, both collected in shallow continental shelf bottoms off Brazil in the second half of the nineteen century, were later referred to *O. fusiformis* by Augener (1934) and Hartman (1959). This treatment is still followed in the World Register of Marine Species, which keeps both species as subjective synonyms of *O. fusiformis*. It is unlikely that they are indeed synonyms of *O. fusiformis*; however, since the original descriptions are succinct, and the type series are severly damaged or in a bad state of conservation (Gustavo Sene-Silva, pers. obs. in an unpublished MSc thesis), the revaluation of their actual taxonomical status is difficult.

Following the recent trend of taxonomic reassessments of the genus and hoping to address a taxonomical identity crisis, we began to re-evaluate *Owenia* from Southern Brazil, describing a new species based on the morphological analysis of estuarine populations collected from the Paranaguá Bay (state of Paraná) and Babitonga Bay (state of Santa Catarina).

MATERIAL AND METHODS

Oweniid specimens were collected from shallow subtidal locations of the Paranaguá Bay (Paraná, Brazil) and Babitonga Bay (Santa Catarina, Brazil). Samplings in Paranaguá Bay were carried out from December 2013 to June 2014 near the mouth of the Baguaçu River (25°33'S, 48°23'W). Subtidal samples were taken with a Petit Ponar grab or shovels manually operated during scuba diving. In Babitonga Bay, samples were taken between April and August 2014 in Paulas Beach (26°13'S, 48°37'W), with a Petersen grab.

The characteristic tubes of *Owenia* were manually separated from the sediment still in the field, stored in plastic jars with water from the collection site, and then taken to the Centro de Estudos do Mar (CEM) at the Universidade Federal do Paraná (UFPR). For morphological descriptions, 16 individuals from Paranaguá Bay and 21 from Babitonga Bay were evaluated (including type-material listed in the corresponding section, and non-deposited individuals); they were removed from tubes and kept in Petri dishes with sea water and 8% magnesium chloride for one hour. At least ten individuals from each site were observed under a stereoscopic microscope for the description of in vivo coloration. The animals were photographed with a Sony NEX3 digital camera. The length of individuals was measured with the aid of a scale built into the stereoscopic microscope.

After fixation, mucus and sediment particles were removed from the body; hooks and chaetae were extracted from four individuals from each site. Fragments of the epidermis with notochaetal bundles on the first abdominal segment and uncini bundles were dipped three times in distilled water for thirty minutes to remove the remaining attached particles. After this, the material was preserved in 70% alcohol. This material was ran through a graded ethanol series to reach the critical point and coated with gold, and examined and photographed in a Zeiss EVO LS15-100 scanning electron microscope (SEM) at the Electron Microscopy Center (CME) at CEM. The terminology and measurements for the descriptions (Figs 1–4) followed the scheme of Koh and Bhaud (2003). Measurements of hard parts, hooks, and notochaetae were based on ten hooks and six notochaetae from the first abdominal segment.

Methyl green colour patterns were assessed by staining five individuals for five minutes with a solution of 0.05 g of methyl green powder in 10 ml of distilled water. Excess was removed by washing in 70% alcohol under visual control in dorsal and ventral thoracic sections were photographed (Martin et al. 2006).

Type-material was deposited at the Zoology Museum of Campinas University, ZUEC (state of São Paulo, Brazil).

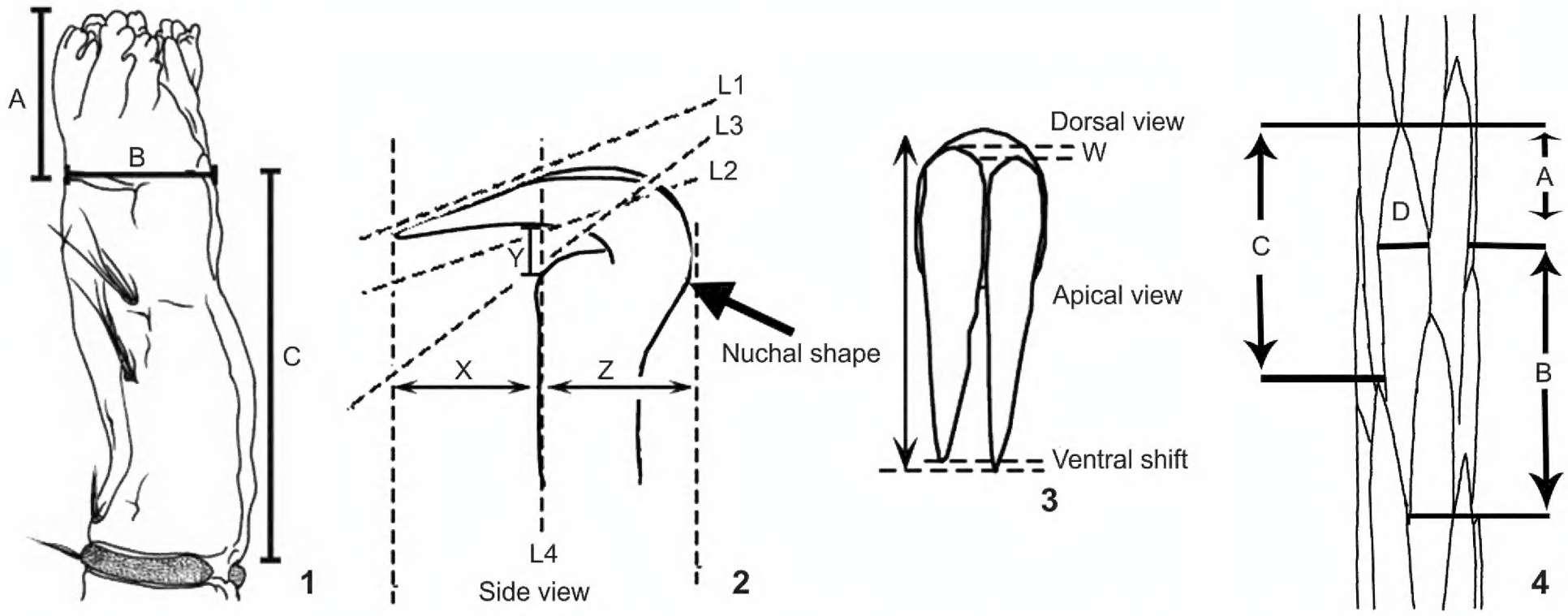
TAXONOMY

Owenia caissara sp. n.

http://zoobank.org/D36477B5-63A6-41B4-9D4B-92EA85C330E1

Diagnosis. Crown with five pairs of tentacles. Tentacular branches beginning near collar base, numerous near crown base and apex. Collar rectilinear, with pronounced lateral slit. Two ventrolateral ocelli partially covered by collar. First abdominal segment with rows of up to 23 hooks. Hooks with 0° to 90° angles in relation to anteroposterior body axis, and nuchal shape regularly curved; teeth curvature moderate. Notochaeta scales long and thin with oval transition between A and B (Fig. 4).

Description (based on holotype; numbers between brackets refer to average measurements in Babitonga and Paranaguá Bay specimens, except body length which represents the maximum and minimum in both places). Body 21 (15–32) mm long. Width at collar height 1.18 (1.16 and 1.24) mm. Body divided into tentacular crown, thorax, and abdomen (Figs 5, 10). Tentacular crown and thorax separated by a thin membrane forming a collar (Figs 6, 7, 11, 14, 17, 20). Rectilinear collar with a lateral slit in angle 63° (77° and 67°) on average. Short crown (crown/abdomen length ratio = 1:2), with five pairs of tentacles (Fig. 17). Dorsal branches longer than ventral branches (Figs 7, 13, 17, 20). Tentacular branches 0.83 (1 and 0.89) mm long. Crown/collar length ratio of 0.70 (0.89 and 0.70). Thorax/collar length



Figures 1–4. Measurements of morphological traits, maximum length of tentacular crown (A), Collar length (B), Thorax length (C). Redrawn from Martin et al. (2006). (2-3) Hook in lateral and apical view, distance between the tip of shaft and teeth ventral margin (X), distance starting from the hook base to the ventral margin of the teeth ends (Y), distance between the manubrium ventral face and teeth distal dorsal face (Z), dorsal and ventral shift of the teeth (W). L1: tangent from the teeth top edge. L2: tangent from the teeth bottom margin. L3: tangent from the shoulder ventral margin. L4: manubrium direction observed in the ventral position. Redrawn modified from Martin et al. (2006). (4) Median section of a capillary notochaeta indicating the meaning of measures A, B, C, and D taken on scales. A: Distance from the free end until the widest scale part. B: Distance from the widest scale part to where it is completely overlapped by two adjacent scales. C: Longest distance between the ends of two successive scales. D: Maximum scale width at which point A and B intersect. Redrawn from Koh and Bhaud (2003).

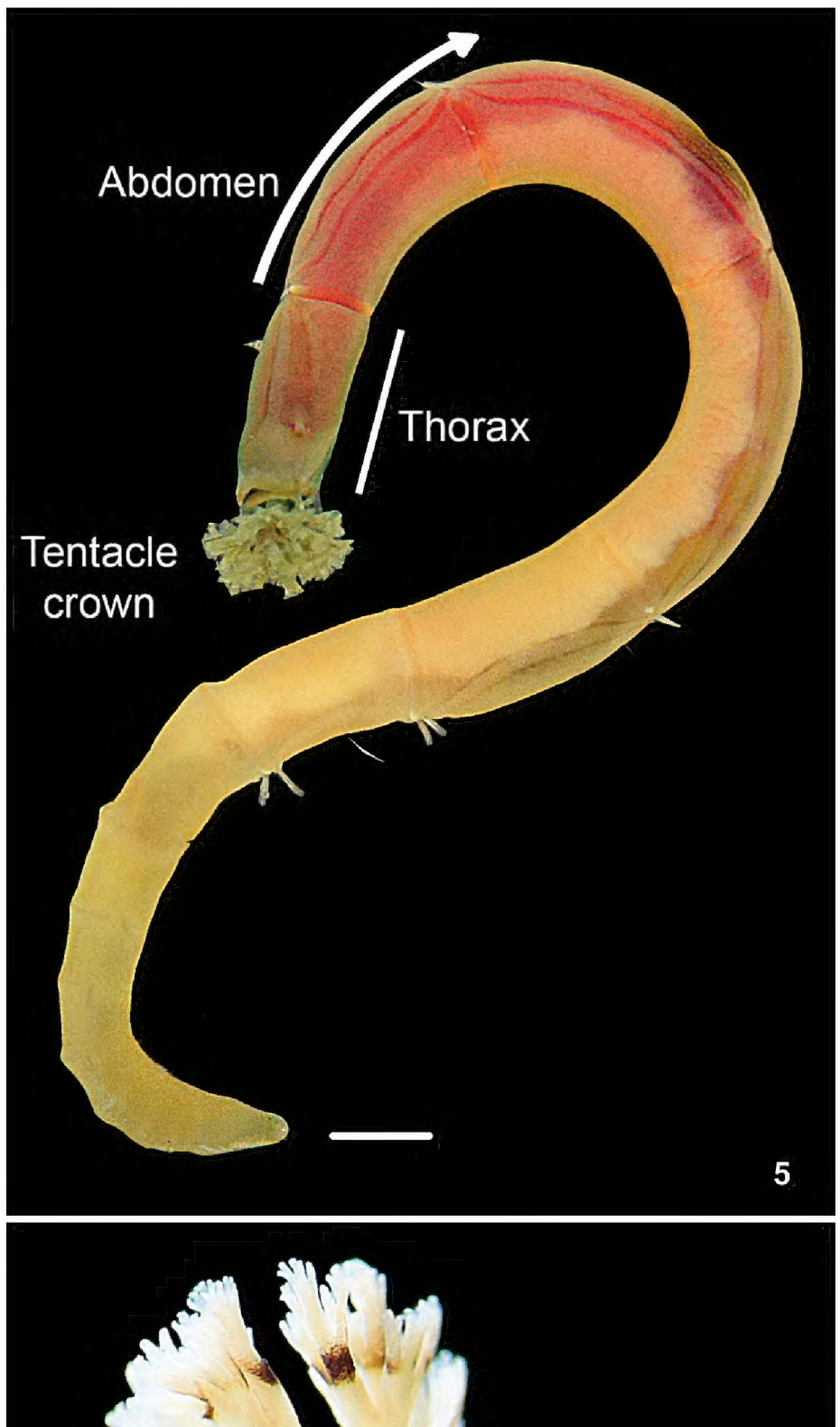
ratio of 1.95 (1.97 and 1.84). Thorax with three segments with capillary notochaetae in lateral bundles on first two segments, dorso-lateral on third segment. Thorax 1.6 (2.12 and 2.22) mm long on average. Abdomen with thirteen to eighteen biramous segments, each one with one pair of capillary notochaetae bundles and one neuropodial ring almost encircling the body. Dorsal ridges of the fifth segment with clavate glandular fractures, curved and expanded, almost touching along the middorsal body line. Posterior abdominal region without a dorsal groove. Neuropodial ring with rows of minuscule bidentate hooks.

First abdominal segment with rows of up to 23 hooks (Figs 18, 21), in 0° to 90° angles in relation to antero-posterior body axis. Teeth on hooks with a space in between, in an inverted V-shape (Figs 23, 24, 26, 27). Hooks with rectilinear shoulder and regularly curved nuchal shape (Figs 16, 19, 22). Average teeth protrusion of 2.02 µm (Figs 4A, 19, 22). Distance between head of shaft and lower part of the teeth (length of opening) 0.83 µm (moderate), (Fig. 2:Y). Hooks were not measured in the holotype to avoid damage to the individual, and following figures are measurements of five individuals from Paranaguá and Babitonga bays, respectively. Maximum hook width (X + Z) of 4.79 and 5.01 µm (Fig. 2) and X/Z ratio of 0.73 and 0.67 (Fig. 2). Moderate teeth curvature, with average angle formed by meeting of L2/L4 tangents from 54° and 63° (Figs 19, 22). Long and thin scales, total length of notochaetal scales on first abdominal segment (A + B) of 4.87 and 4.29 µm (Figs 4, 25, 28). A + B/D ratio of 9.9 (Figs 4, 25, 28). Average length of scale's free part (C) of 2.5 µm and 2.32 µm (Fig. 4). Oval transition area between A and B (Figs 4, 15, 25, 28).

Living specimens with dark brown coloration at the base and terminal region of tentacular branches (Figs 11, 13). Red tinged thorax and beginning of abdomen due to body transparency, which highlights vascularization; remaining abdomen pinkish (Figs 5, 10). Color absent in alcohol – preserved animals, except one pair of reddish ocelli at ventrolateral base of tentacular branches, partially covered by collar (Figs 6, 9), and brown spots basally on tentacular branches and on terminal regions (Figs 6, 7).

Methyl green staining pattern characterized by tentacular branches unreceptive to staining, dorsal side of the collar and two longitudinal dorso-lateral lines strongly stained. On the ventral side, the two V shaped lines were unreceptive to methyl green but the border of these lines and the collar were strongly stained (Fig. 29, Table 1).

Tubes with medium and coarse particles (481-586 µm), coalesced by mucus in an imbricated pattern. In cross-section, smaller particles near lumen and larger on tube edge. Quartz particles dominates (99%) followed by magnetite (0.6%), biotite (0.37%), and shell and echinoderm fragments (0.03%). Tubes from 26 to 57 mm long (n = 70).



Figures 5–6. *Owenia caissara* sp. n. from Paranaguá Bay, Polychaeta 17525; lateral view showing the three body regions: tentacular crown, thorax, and abdomen (5), cephalic region in dorsal view showing dark brown pigmentation at the base and near the apex of tentacles in one specimen fixed in 70% alcohol (6). Scale bars: 1 mm (5), 1.4 mm (6).

Material examined. Holotype: ZUEC Polychaeta 17486, 21 mm, Santa Catarina, Babitonga Bay, Paulas Beach, 15/Jun./2014. Paratypes: ZUEC Polychaeta 17517-17522, Santa Catarina, Babitonga Bay, Paulas Beach, 22/Aug./2014, 6 specimens; Polychaeta 17523-17525, Paraná State, Paranaguá Bay, Cotinga Channel, 4/Jun./2014, 3 specimens; ZUEC Polychaeta 17487-17516, Santa Catarina, Babitonga Bay, Paulas Beach, 3/Oct./2014, 29 specimens.

Type locality. Paulas Beach, Babitonga Bay, Santa Catarina State, 26°13'S, 48°37'W.

Distribution. Currently known only from estuarine habitats along the coasts of the states of Paraná and Santa Catarina (Brazil).

Etymology. The species name honors fisherfolk from traditional communities still found along the southern and southeastern Brazilian coasts. We prefer the archaic spelling "caissara" to the modern "caiçara" to avoid the usage of the cedilla diacritical mark in the taxonomic literature.

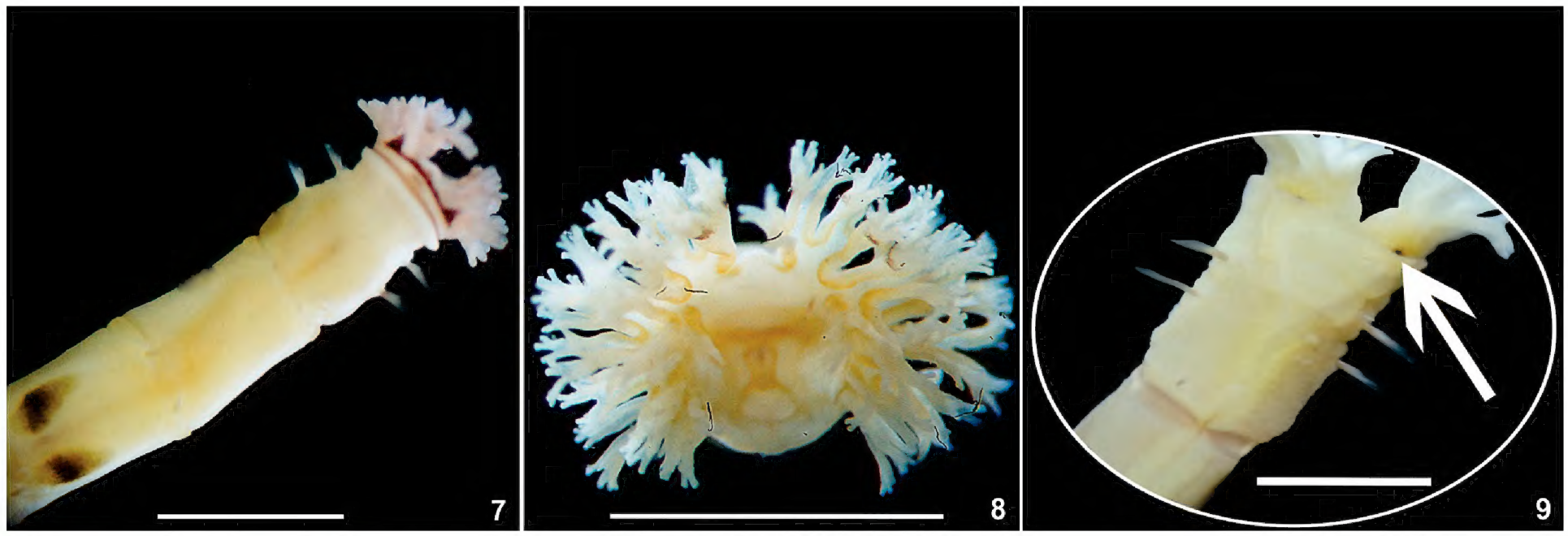
Habitat. Populations of *Owenia caissara* sp. n. are frequent in shallow subtidal bottoms with a predominance of medium sand, at 0.5 to 5 m depth at Babitonga and Paranaguá Bays.

Remarks. *Owenia caissara* sp. n. has five pairs of tentacles (four in *O. fusiformis*), a tentacular branching close to the collar base (clearly more terminal in *O. fusiformis*), a collar with a pronounced slit (absent or inconspicuous in *O. fusiformis*), ventrolateral ocelli partially covered by the collar (completely exposed in *O. fusiformis*), hooks of the first abdominal segment in 0° to 90° angles (varying from 0° to 5° in *O. fusiformis*) and the transition between A and B (Fig. 4) on scales is oval (curved in *O. fusiformis*, Koh and Bhaud 2003), tentacular branches unreceptive to staining (strongly receptive in *O. fusiformis* tentacular branches) (Table 1).

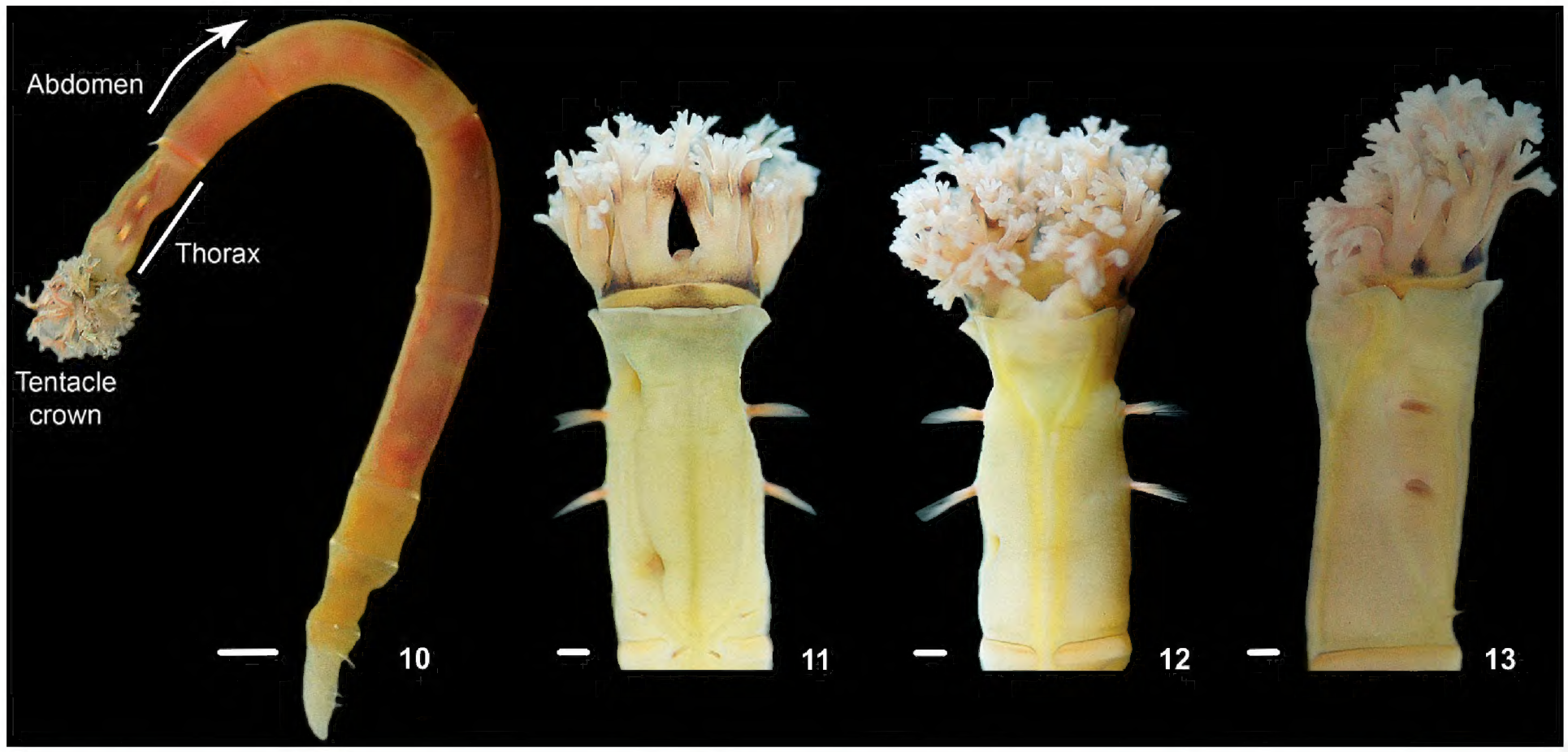
The Californian *O. johnsoni* and *O. collaris* differ from *O. caissara* sp. n. in having four tentacular branches with few dichotomies. In *O. johnsoni*, the crown is long and hooks are in a 45° angle on the first abdominal segment. In *O. collaris*, the angle of the first abdominal segment ranges from 30° to 45°.

The Korean species *O. gomsoni* differs from *O. caissara* sp. n. in having five or more pairs of tentacles (always five in *O. caissara* sp. n.), a curved collar (straight in *O. caissara* sp. n.) and a transition area of notochaeta scale angular (oval in *O. caissara* sp. n.), tentacular branches strongly receptive to staining (unreceptive in *O. caissara* sp. n. tentacular branches), V shaped lines strongly receptive to methyl green (unreceptive in *O. caissara* sp. n.) (Table 1).

Owenia *borealis* and *O. polaris* differ from *O. caissara* sp. n. in having only four pairs of tentacular branches, an angular collar (straight in *O. caissara* sp. n.) and an angular transition area in notochaeta scale (oval in *O. caissara* sp. n.). In addition, the dorsal and ventral tentacles do not differ in size in *O. polaris*, and the tentacular branches are receptive to staining (Table 1). *Owenia persica* and *O. petersenae* differ from *O. caissara* sp. n. in having only four pairs of tentacular branches. Moreover, *O. persica* has the dorsal and ventral tentacle branches equal in



Figures 7–9. *Owenia caissara* sp. n. from Paranaguá Bay, Polychaeta 17524; in dorsal view (7), in frontal view with tentacular branches in detail (8), in ventral view with ventrolateral ocelli partially covered by the collar (9). Scale bars: 3 mm (7), 2 mm (8), and 1.5 mm (9).



Figures 10–13. *Owenia caissara* sp. n. from Babitonga Bay, Polychaeta 17520; lateral view showing the tentacular crown, thorax and abdomen (10), anterior region in dorsal view (11), anterior region in ventral view (12), anterior region in lateral view (13). Scale bars: 1 mm (10), 0.2 mm (11, 12 and 13).

size, the first tentacular branches are far away from the collar, which is angular, and the hooks lack shoulders. In *O. petersenae* dichotomies of tentacles are only observed at the distal end, the collar is curved (convex), and the tentacular branches are receptive to staining (Table 1).

The Australian *O. australis*, *O. mirrawa*, *O. dichotoma* and *O. picta* differ from *O. caissara* sp. n. in having four pairs of tentacular branches. *Owenia dichotoma* has a shorter tentacle crown with fewer ramifications than *O. caissara* sp. n. and *O. picta* has fewer tentacle crown ramifications than *O. caissara* sp. n., and a bilobed structure between the tentacles of the left and right sides in ventral view, which is lacking in *O. caissara* sp. n. (Table 1).

The specimens collected in Ubatuba (Northern coast of São Paulo, SE Brazil) differ from *O. caissara* sp. n. in having four pairs of tentacular branches with dorsal and ventral branches of equivalent length and the angles of the hooksranging from 0° to 45° in the first abdominal segment (Table 1).

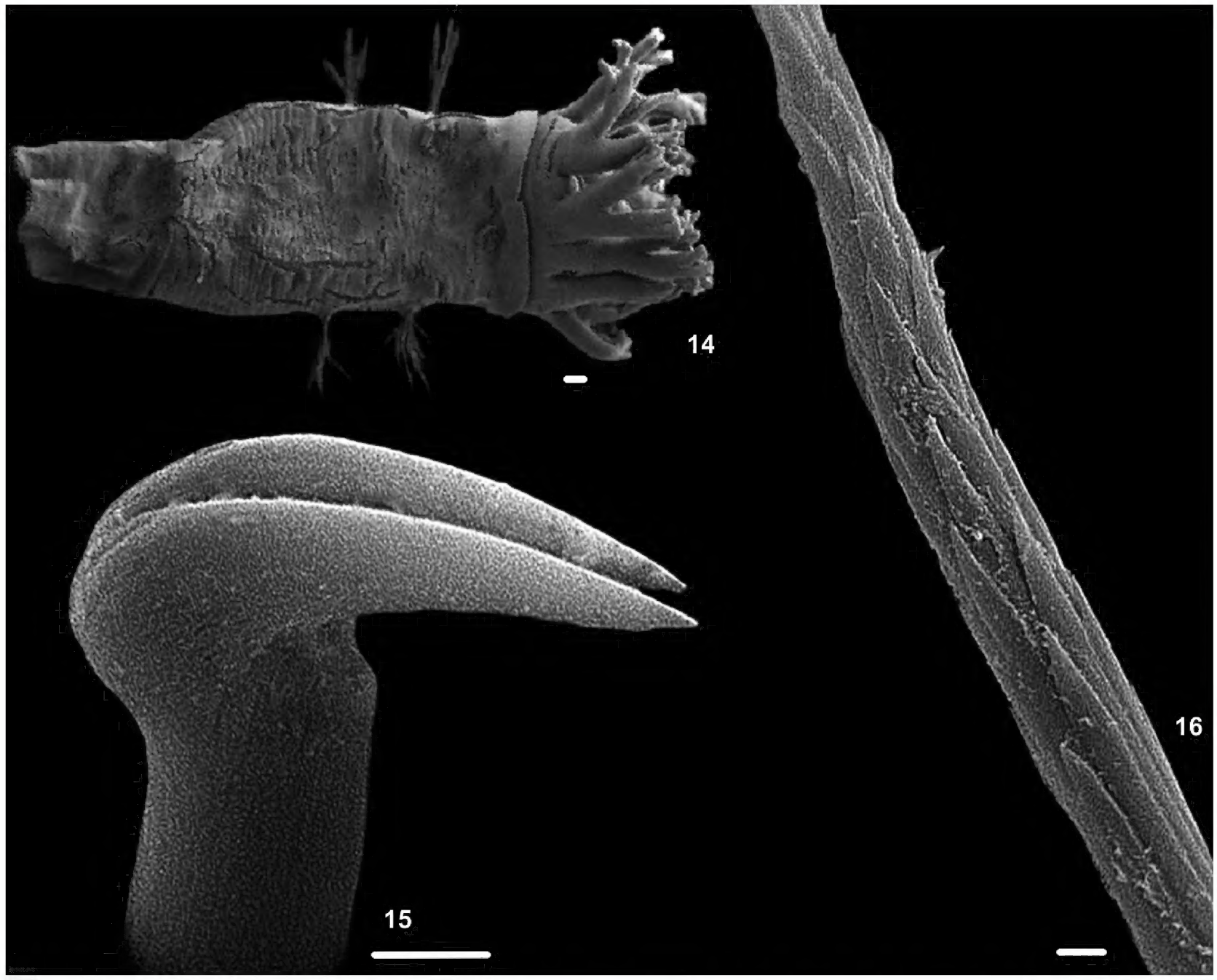
Table 1. Main characters used to distinguish *Owenia* species (modified from Koh and Bhaud 2003).

Caracteres		*O. johnsoni* - California	*O. collaris* – California	Ubatuba – Brazil	*O. caissara* – Paranaguá Bay – Brazil	*O. caissara* – Babitonga Bay – Brazil	*O. borealis* - Iceland	*O. polaris* – Norwegian Sea	Portugal	Seine Bay	*O. fusiformis* – Banyuls Bay	*O. persica* – Persian Gulf	Madagascar Tulear	*O. gomsoni* – Yellow Sea	Japan Sea	West of Australia	*O. mirrawa* - Australia	*O. bassensis* - Australia	*O. australis* - Australia	*O. dichotoma* - Australia	*O. picta* - Australia	*O. petersenae* – New Zealand
Size	Branchial lenth (1)	L	M	S	M	M	S	S	M	M	M	L	M	M	S	M				S	M	L
	Thorax length (2)	L	M	M	M	M	M	M	L	M	M	L	M	M	M	M	S	S	S			M
	Body width (3)	M	M	L	M	M	M	M	M	M	M	S	L	L	M	S						M
	Number of segments (range)	19 – 20	20		13 – 21	16 – 21	22	18 – 22		19 – 24	21 – 30	8 – 23		22 – 24			14	17	19		22	
Tentacles	Number of trunks	4	4	4	5	5	4	4		4	4	4	4	5	4	4	4	3	4	4	4	4
	Dorsal and Ventral length	≠	≠	=	≠	≠	≠	=	≠	≠	≠	=	≠	≠	=	≠		≠	=		=	≠
Collar	Curved									*			*	*		*						*
	Straight	*	*	*	*	*			*		*				*		*	*	*	*	*	
	With angle						*	*				*										
	Slit length: Short, Middle or long	S	M	M			M	M	S	S	M	M	S	M	M	M						L
Thorax	Line of 3 thoracic bundles: / or _/	/	_/	/	_/	_/	/	_/	/	_/	_/	_/	/	_/	_/	/						_/
	Direction (°) of hooks on abdominal segment 1 (range)	0	30 – 45	0 – 45	0 -90	0 -90	45	0 -10	45	0 -90	0 – 5	45	70 -90	0 -30	10 -90	45						30 -90
Hooks	Length of tooth (X) (4)	M	L	M	M	M	S	M	M	M	M	S	L	M	M	S						M
	Length of opening (Y) (5)	M	M	M	M	M	M	M	S	M	M	L	M	M	M	M						S
	Ratio X/Z (6)	M	M	M	M	M	S	M	M	M	M	M	M	M	M	M						M
	Angle of tooth (7)	S	B	M	S	S	B	B	M	M	M	M	M	S	M	B						S
	Dorsal shift present (pr), or absent (ab)	pr	pr	ab	pr	pr	pr	pr	ab	pr	ab	pr	pr	ab	ab	pr						pr
	Ventral shift present (pr), absent (ab)	pr+	pr+	pr+	pr	pr	pr	ab	pr	pr	pr	pr	ab	pr	pr	pr						pr
Scales on chaetae	Length (a + b)/d (8)	M	M	L	L	L	S	M	L	M	M	M	S	M	M	M						L
	Sharpness (a/d) (9)	A	A	S	M	M	A	M	S	S	M	M	A	S	M	S						S
	Length of free part (c) (10)	L	M	L	M	M	S	M	L	M	M	L	S	S	M	M						L
	Transition area: < > or ( )	< >	< >	( )	( )	( )	< >	< >	( )	< >	< >	( )	( )	( )	< >	( )	( )	( )	( )			( )
Methyl Green Staining	Tentacles			–	–	–	+				*	–		*	–							*
	Dorsal collar			*	+	+	+			*		+		+								*
	2 ventral lines of thorax			–	–	–	–			–	–	–		+	–							–
	V-shaped area from mouth to setiger 2																					

(1) A/C (Branchial length/Collar length, Fig. 1) ≥ 1.27 : L (long), ≤ 0.68 : S (short), 0.68 < M < 1.27; (2) B/C (Collar length/Thoracic length, Fig. 1) ≥ 2.62: L (long) ≤ 1.41 : S (short), 1.41 < M < 2.62; (3) B (Collar length, Fig. 1) ≥ 1.36 mm : L (long), ≤ 0.73 mm : S (short), 0.73 < M < 1.36; (4) X (See Fig. 2) ≥ 2.93 µm : L (long), ≤ 1.58 µm : S (short), 1.58 < M < 2.93 ; (5) Y (See Fig. 2) ≥ 1.37 µm : L (long), ≤ 0.74 µm : S (short), 0.74 < M < 1.37
(6) X/Z (See Fig. 2) ≥ 0.98 : L (long), ≤ 0.53 : S (short), 0.53 < M < 0.98; (7) L2/L4(°) (See Fig. 2) ≥ 80 : B (big), ≤ 70° : S (small), 70° < M < 80°; (8) (A+B)/D (See Fig. 4) ≥ 9.01 : L (long), ≤ 4.85 : S (short), 4.85 < M < 9.01; (9) A/D (See Fig. 4) ≥ 3.12 : S (sharp), ≤ 1.68 : A (acute), 1.68 < M < 3.12; (10) C (See Fig. 4) ≥ 4.30 µm : L (longo), ≤ 2.32 µm : S (curto), 2.32 < M < 4.30; (11) *: strong coloration, +: coloration, – : without coloration.

DISCUSSION

Although direct comparison with type-material from other species is an almost mandatory practice to describe a new species, most of this material was not available for loans to Brazil. We are convinced that *Owenia fusiformis* and related taxa are morphologically close but not cryptic, and we believe that morphological characters provide good evidence to recognize and treat them as separate evolutionary lineages. Very good and detailed descriptions of some of the closest species to *O. caissara* sp. n. are currently available and were extensively used in our study (see Table 1). Due to the loss or bad state of conservation of their type series (communication by Gustavo Sene-Silva, a former student of PCL), we decided not to detail the taxonomic affinities

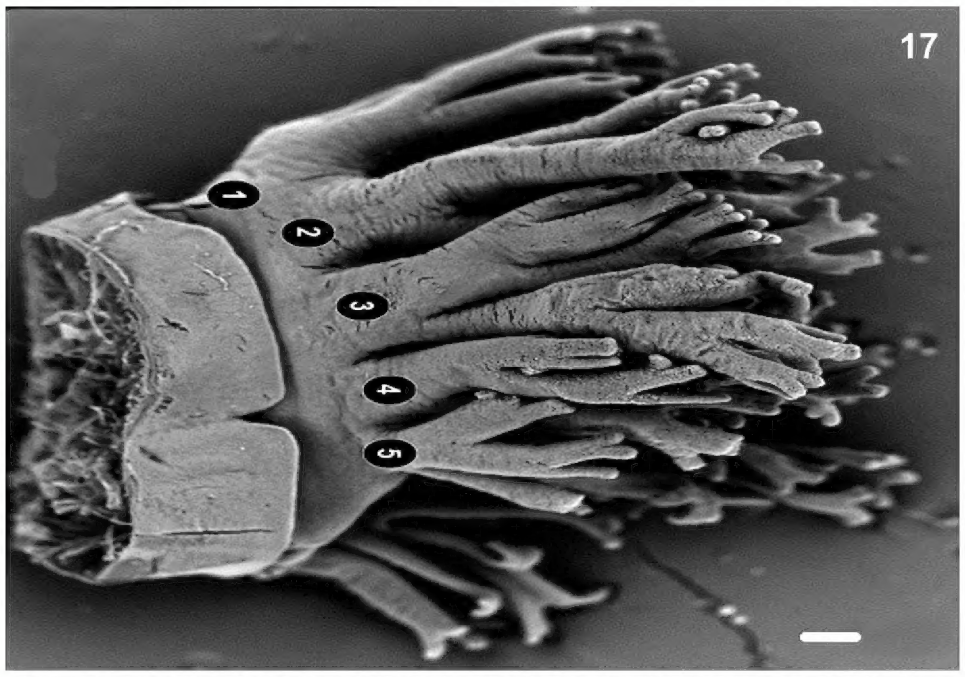


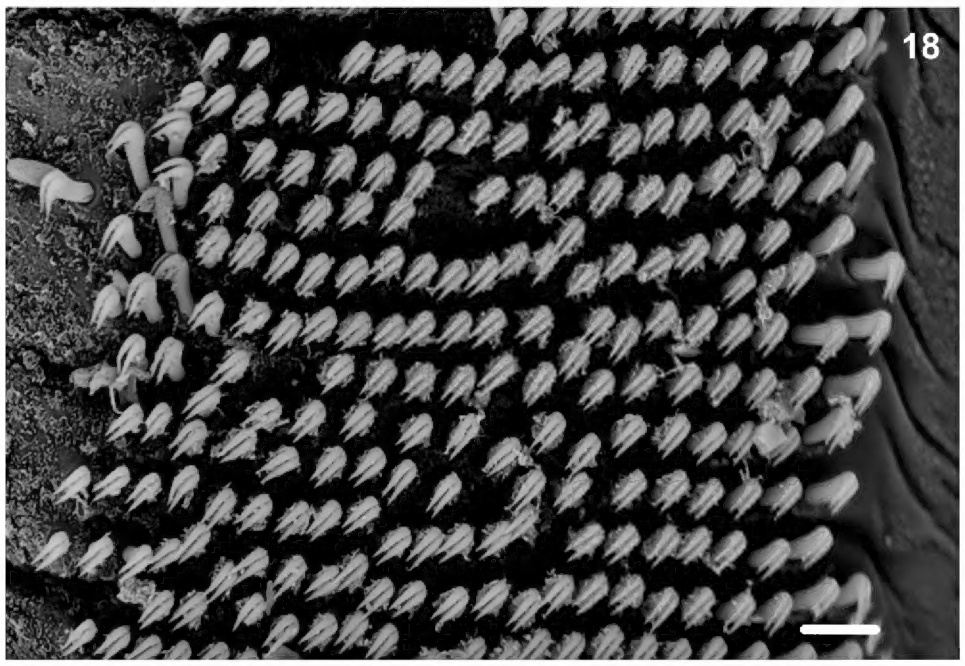
Figures 14–16. *Owenia caissara* sp. n. from Babitonga Bay, Polychaeta 17522. Anterior region in lateral view showing tentacular crown, thorax, and first neuropodial ring (14), scales on notochaeta from the first abdominal segment (15), lateral view of a hook from the first neuropodial ring (16). Scales bars: 100 µm (14), 1 µm (15 and 16).

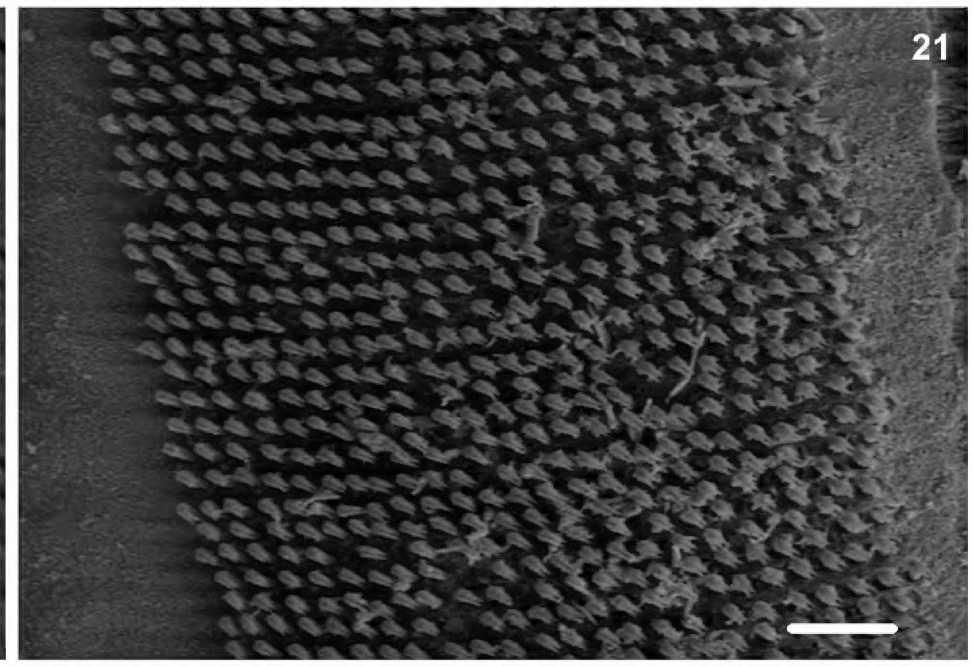
of *O. sundevalli* (Kinberg, 1867), *O. tegula* (Kinberg, 1866) and *O. brasiliensis* (Hansen, 1882), from shallow continental shelf bottoms off the southwestern Atlantic. However, even if succinct, their original descriptions strongly indicate that they differ from *O. fusiformis* and *O. caissara* sp. n., so that re-description, revalidation, and neotype designation are much needed. Since geographic range and habitat preferences are also good criteria to separate species of *Owenia*, we thus believe that the current delineation of *O. caissara* sp. n. is well justified and rely on multiple lines of morphological and biogeographical evidence.

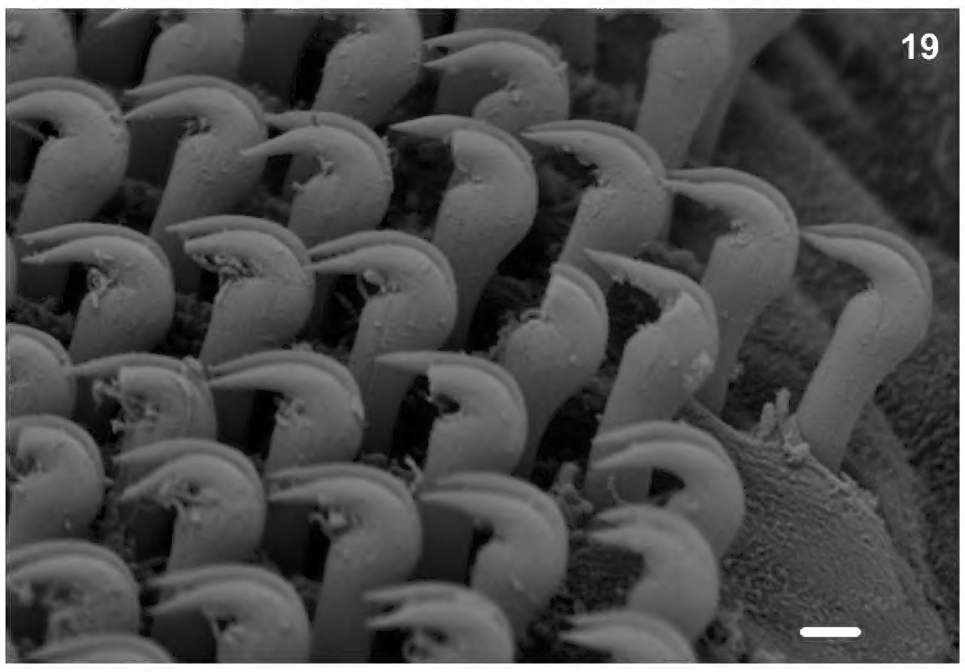
By describing a new species from southern Brazil, previously referred to as *O. fusiformis*, we reinforce the growing understanding of the large worldwide diversity of *Owenia*, supporting that the existing environmental barriers effectively limit larval dispersal (Norris and Hull 2012). Taxonomically robust morphological characters allowed for the unambiguous recognition of a new taxon, contributing to mitigate a true identity crisis still persistent in the regional literature.

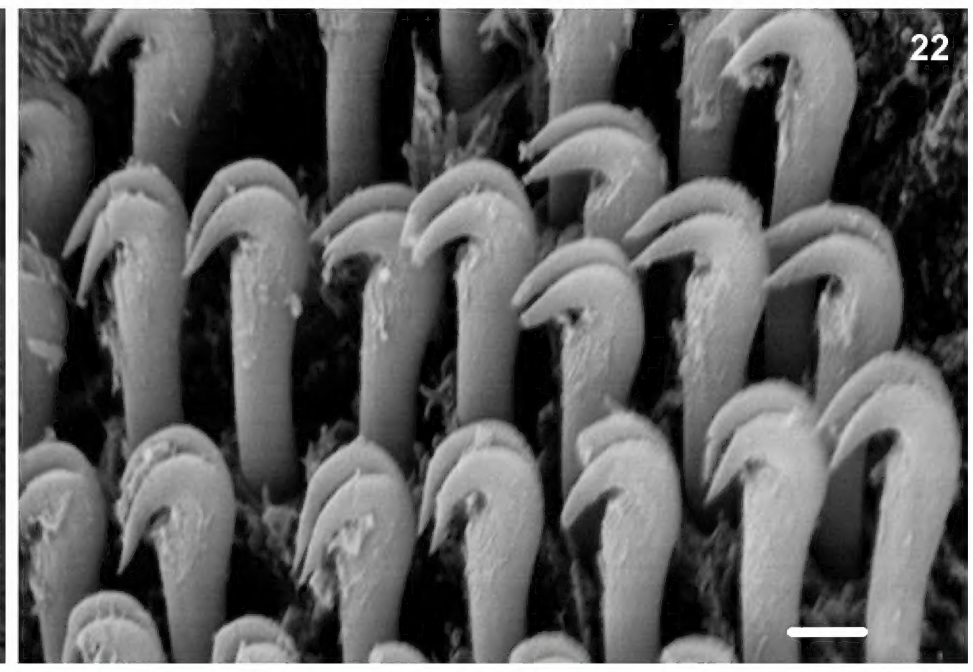
We emphatically anticipate the need for a taxonomic revision of the material so far recorded along the southwestern Atlantic, by combining both modern morphological criteria and molecular data. Even in the absence of such revision, we do not recommend keeping *O. sundevalli*, *O. tegula*, and *O. brasiliensis* as synonyms of *O. fusiformis*, which is still the case in the World Register of Marine Organisms (Read 2015). Traits such as the number of body segments and length of the tentacular crown are not diagnostic at the species level, and should be considered unreliable or inconsistent for the diagnosis or synonymies among the species of *Owenia* (Koh and Bhaud 2003, Ford and Hutchings 2010). Trying to address this issue, Blake (2000) and Koh and Bhaud (2001, 2003) used additional or novel macro- and microscopic morphological features based on hard structures. Moreover, since measurements of soft parts are prone to errors due to tissue contraction after fixation, they suggested the usage of relative proportions, as the tentacular crown vs. thorax length ratio. Ford and Hutchings (2010) showed, however, that even



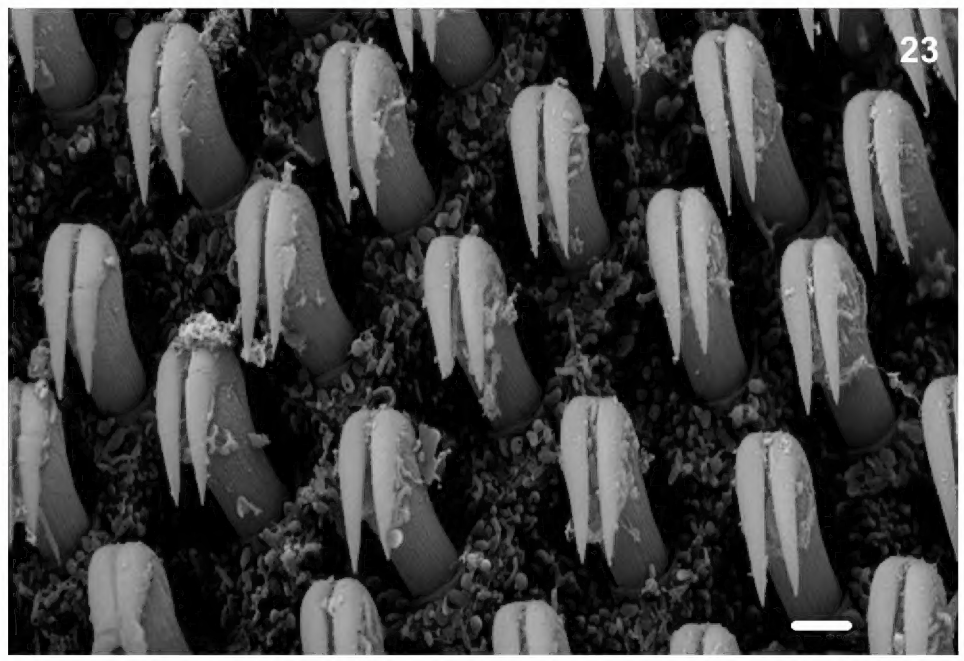


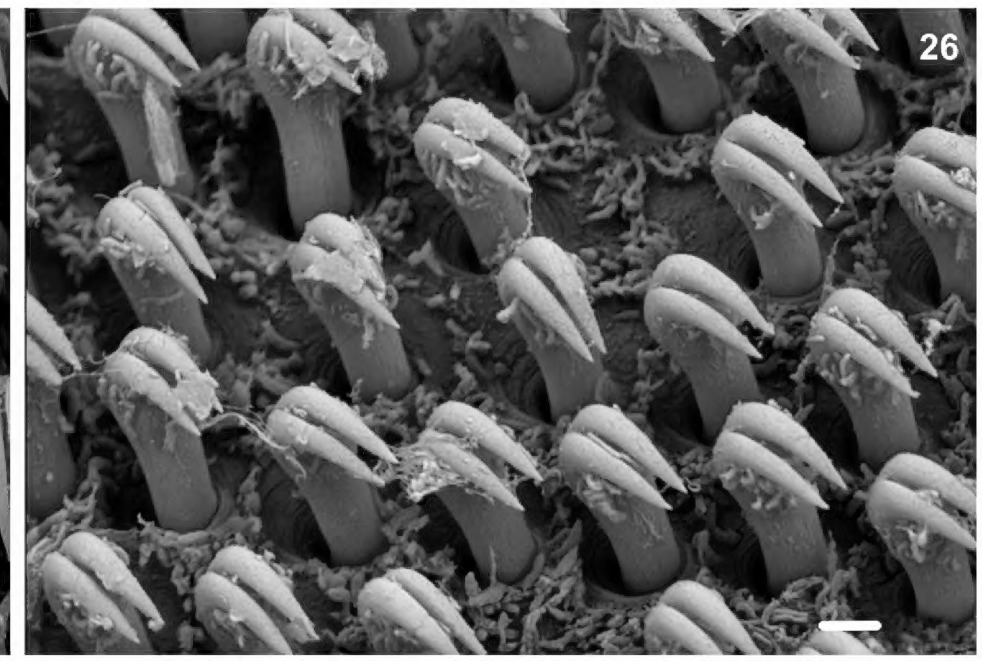


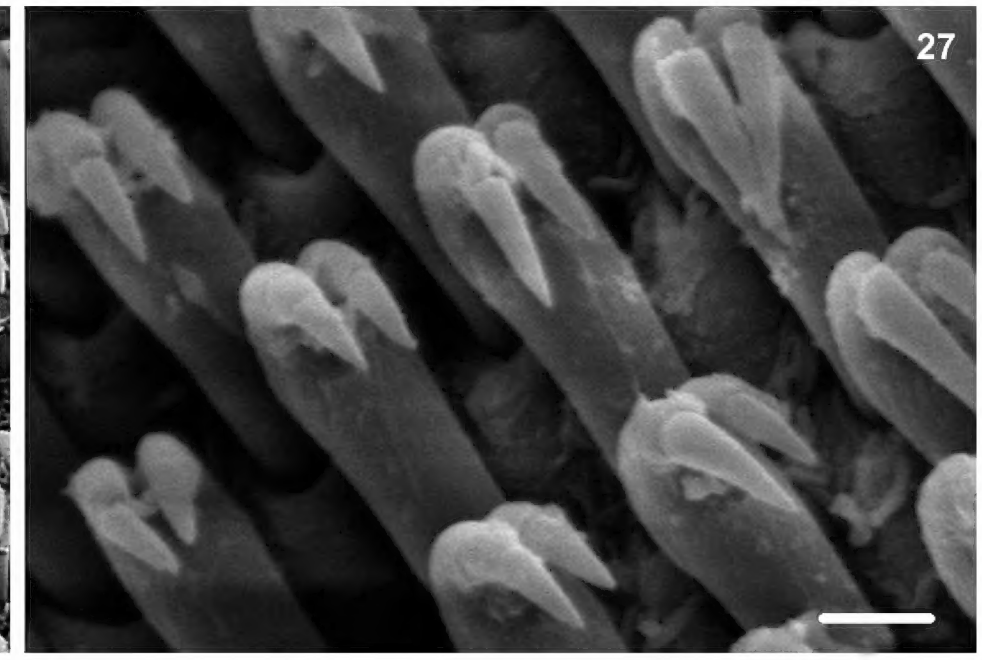


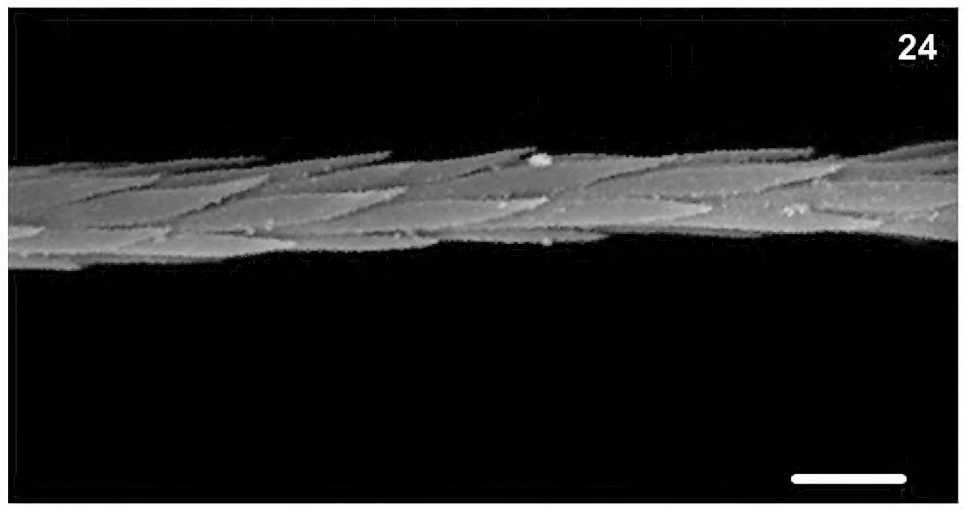


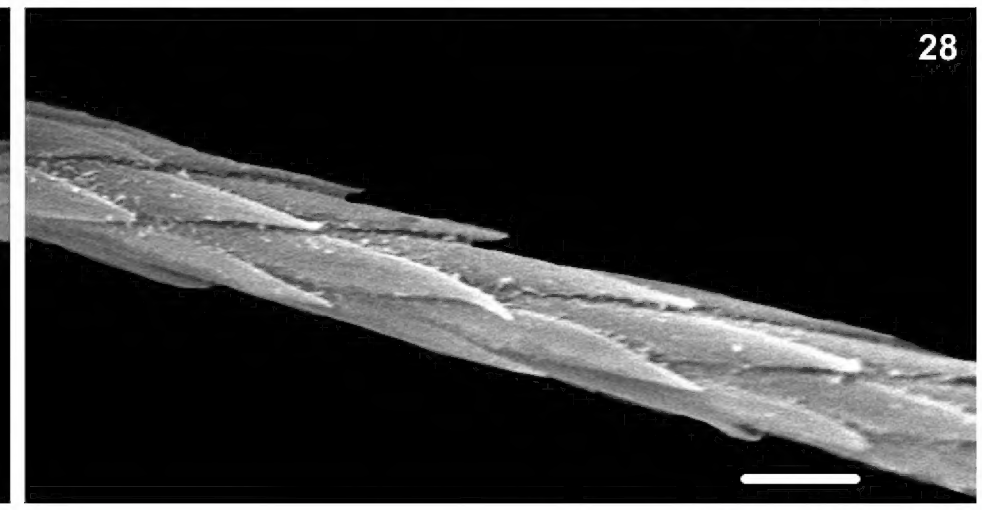
Figures 17–22. SEM Images. 17-19 (first column), *Owenia caissara* sp. n. from Babitonga Bay Polychaeta 17518, 17519. 20-22 (second column), *Owenia caissara* sp. n. from Paranaguá Bay. 17 and 20, tentacular crown and thorax portion; 18 and 21 band of neuropodial hooks on the first abdominal segment (band median portion of band); 19 and 22, lateral view of hooks on the first abdominal segment. Scale bars: 100 µm (17 and 20), 10 µm (18), 2 µm (19), 20 µm (21), 3 µm (22).











Figures 23–28. SEM Images. 23–25 (first column), *Owenia caissara* sp. n. from Babitonga Bay, Polychaeta 17517, 17518. 26–28 (second column), *Owenia caissara* sp. n. from Paranaguá Bay, Polychaeta 17523. 23 and 26, apical view of hooks on the first abdominal segment; 24 and 27, frontal view of hooks on the first abdominal segment; 25 and 28, median portion of notocheata from first abdominal segment, showing scales. Scale bars: 2 µm (23), 5 µm (24), 2 µm (26, 28), 4 µm (25), 1 µm (27).

the relative proportions may vary depending on the animal's age due to allometric growth.

Chitinous structures, such as hooks and other chaetae, do not suffer alterations or deformation after fixation. Therefore, the use of morphometric proportions and measurements of hard 'structures would also allow for a better assessment of intra- and interspecific variability. However, there is still no consensus that morphometric data are sufficient for the unequivocal recognition of new species. For example, the significant variability between chaetal scales in one single individual may hinder the usefulness of this character to diagnose species. The same holds true for the number of hooks in neuropodial rows, which is also influenced by animal development.

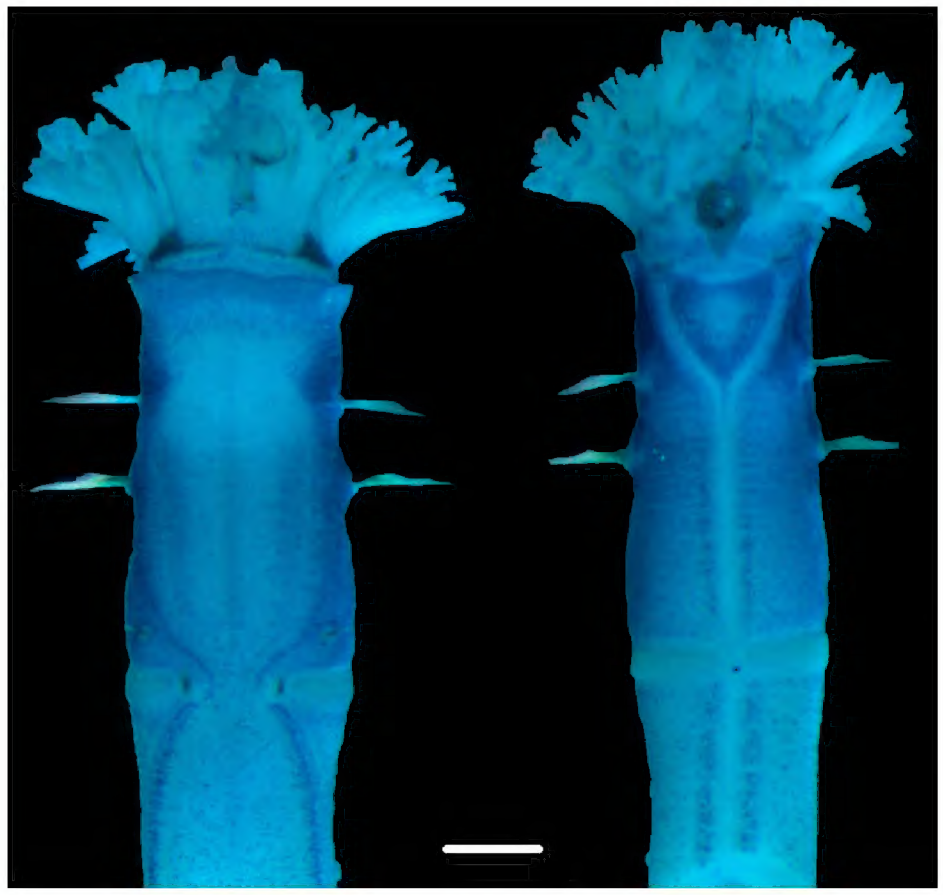


Figure 29. Methyl green colour pattern of anterior end of the body in dorsal (left) and ventral (right) views. Scale bar: 5 µm.

Koh and Bhaud (2003) suggested that the high morphological variability found in *Owenia* should be evaluated with caution since it can only reflect inter-population phenotypic plasticity. Unfortunately, the few available studies addressing growth and development are restricted to the Mediterranean *O. fusiformis* (Gentil et al. 1990, Dauvin and Gillet 1991).

The question about using *Owenia* tubes as useful diagnostic features for species recognition remains open. Koh and Bhaud (2001, 2003) noticed that the greater or lesser prevalence of shells, quartz, and heavy minerals, could reflect interspecific variability. Experiments conducted with populations from the Mediterranean and Yellow Seas indeed demonstrated distinct preferences for certain particles for tube building. Mediterranean animals preferred particles of quartz and carbonate while those from the Yellow Sea preferred only quartz particles (Koh and Bhaud 2001). Conversely, Ford and Hutchings (2010) suggested that this apparent preference would only indicate greater or lesser availability of these materials in the sediment, making it difficult or impossible to use this feature to distinguish between species. Therefore, further studies on the ability to select particles and its possible diagnostic and taxonomic implications are needed. Strategies and tube-building strategies by *O. caissara* sp. n. will be presented elsewhere.

The difficulty in effectively establishing diagnostic morphological characteristics for the recognition of *Owenia* species still remains. Molecular data will likely help to address the still prevalent identity crisis of the genus along the southwestern Atlantic. Unfortunately, the availability of molecular data is still incipient, and the sequences available on GenBank have not yet been used for phylogenetic studies or species differentiation.

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